Role of Fuzzy Expert System to Diagnosis Human Diseases

[1]Tanmay Kasbe, [2]Ravi Singh Pippal
[1]Researh Scholar, [2]Professor
[1]Department of Computer Science
[1]RKDF University, Bhopal, India

Abstract— **Diagnosis of human disease is one of the complicated & difficult processes and it requires high level of expertise. Fuzzy expert system is one of the best systems to diagnosis medical disease because any disease diagnosis has so many uncertainties and fuzzy logic is the best tool to deal with uncertainty. Despite the fact that there are some limitations due to information, educational and other reasons these systems are widely acknowledged in medical institutions operating in all levels of healthcare. By the help of fuzzy expert system, one can easily diagnose the level of disease in an infant by just giving proper values of the inputs. The aim of this paper to show all disease used by fuzzy expert system and disease is not covered so far. This paper also shows the accuracy of disease, implemented by many researchers with past contribution are reviewed and analyzed.**

Index Terms— **Fuzzy Expert System, Human Disease, Uncertainty, Disease Diagnosis** *(keywords)*

I. INTRODUCTION

The advancements of computer technology are playing a important role in diagnosis of medical systems. Medical diagnosis is full of uncertainty and dynamically changed according to the situations. Expert Systems is an smart computer is based on decision making tool that uses dataset and rules to solve real life problems based on knowledge obtained from one or more of a human expert in a specific areas. Medical Diagnosis system is a system which can diagnose any diseases through checking out the symptoms. Fuzzy Expert System (FES) is playing an important role in medical diagnosis because it has contained lots of uncertain data with lots of key factors. Fuzzy expert system derived from fuzzy logic.

Fuzzy logic is advance version of Boolean logic. Fuzzy logic first was introduced in the year of 1930 by Polish Philosopher Jan lukasiewicz. Later in 1965, Lotfi Zadeh regenerate fuzziness and explored in broad way. Fuzzy logic works on the concept of mathematical principles to represent knowledge base and degree of membership rather than binary logic. Fuzzy logic based on multivalve whereas Boolean logic based on only two values. An expert system that used fuzzy logic is known as fuzzy expert system. Fuzzy expert system is a collection of fuzzy rules, membership functions and fuzzy rules that are used to reason about Data.

In fuzzy expert system, for implementation purpose, we must create a rule based and for making a rule we must required an expert person who can explain us the utility of all variables used in FES. Only making an expert system is not enough in medical diagnosis because it is related with real life so accuracy of expert system must be close with the expert like doctor. To achieve high accurate results, the diagnostic expert system, use the medical expert's justifications i.e. the concept of Explain. It is obvious that expert systems need medical science rules and dataset of medical diseases and conditions to provide accurate results. The Fuzzy Expert System has proved its usefulness in the medical diagnosis area for the quantitative analysis and qualitative evaluation of medical data, achieving the correct accuracy of results.

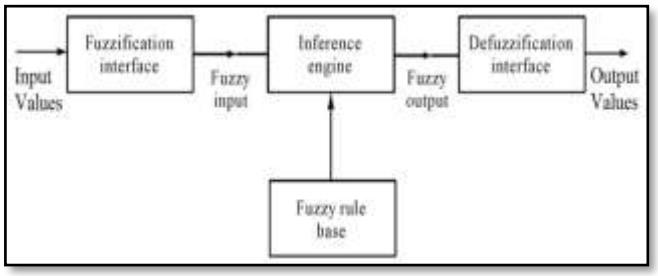

Fig.1: Fuzzy Expert System

II. LITERATURE REVIEW

J.B. Awotunde et al. [1] explain the concept of fuzzy logic used in medical disease with practical implementation of malaria. In this paper, authors provide the entire input variable with their range and also explain about the fuzzy rule of malaria. They have implemented FES on 20 patients with higher accuracy. In the year of 2013, ***Smita Sushil Sikchi*** et al. [2] introduce a role of fuzzy expert system in medical diagnosis with other applications. They also had given data of last two decades, in which researcher done their work in fuzzy expert system. In this paper, general methodology with step by step implementation is introduced. ***Mir Anamul Hasan*** et al. [3] presented a paper on human diagnosis by using fuzzy expert system. Authors explain proposed system with methodology and also explain the importance of fuzzy role in any disease implementation. ***Preety Dagar et al. [4]*** introduce the concept of expert system concept and explain in detail how to use fuzzy expert system in diagnosis of medical disease. In this paper, they had given introduction of MATLAB software and also explain how to use MATLAB for creating a input variable, rule viewer and centroid technique for defuzzification.

In the year of 2013, ***Manish Rana [5]*** designed a fuzzy expert system for various medical disease diagnoses. In this paper, he had given details of diagnosis of thyroid, brain disease and heart attack disease. He has provided all the implementation detail with result and also discussed the comparison of tools. ***Nidhi Mishra and P. Jha [6]*** presented a review paper on fuzzy expert system for disease diagnosis. In this paper, authors given complete review of others authors work related to recent work of fuzzy expert system in medical area. **Smita Sushil Sikchi and Sushil Sikchi [7]** discussed a survey paper on fuzzy expert system. In this paper, they had explained application of FES, Recent Trends in FES and future scope of fuzzy expert system in medical disease. In the year of 2015, ***Varinder Pabbi*** [8] design and implemented a fuzzy expert system for medical diagnosis in which he had given complete detail (Symptoms & sign) of some of the disease diagnosis like diabetes problem. He also given introduction of fuzzy logic toolbox for showing the result based on the inputs and fuzzy rules.

Chandresh Arya and Ritu Tiwari [9] presented a survey paper on breast cancer disease. In this paper, they had explained several artificial approach like fuzzy logic approach, neural network approach and hybrid approach. They had given high accuracy in each approach done by researchers in past. In the year of 2015, ***Farahani et al. [10]*** designed and implemented a fuzzy expert system for diagnosis of lung cancer. They have used MATLAB tool for implementation and got a knowledge base from American Cancer Society. ***Ali.Adeli and Mehdi.Neshat [11***] developed a expert system for diagnosis of heart disease. They have used UCI machine dataset and MATLAB tool for graphical user interface (GUI) with accuracy of 94%. In this paper, they had given complete information like input variable with their ranges, membership functions and fuzzy rule base with output. ***Sanpreet Singh [12]*** introduced a concept of diagnosis of mental illness and he had implemented complete fuzzy expert system.

E.Sreedevi and M.Padmavathamma [13] proposed a neuro fuzzy expert system for diabetes. In this paper they have mentioned all types of diabetes with their symptoms. ***Vishal Bhandari and Rajeev Kumar [14]*** compare all the research on diabetes which is done on AI techniques including all the approaches. In this paper, they have given comparative analysis of all the approaches in tabular format. They had also mentioned the accuracy of system. ***M.Neshat et al. [15]*** developed a fuzzy expert system for liver disorder. For implementation they have used MATLAB tool and also used UCI database for dataset of liver diagnosis. In this paper, they have explained about membership function, input variable and fuzzy rules for diagnosis of liver. They have achieved 91% accuracy of liver diagnosis which is the highest among all the researchers.

Mehdi.Neshat and Mehdi.Yaghobi [16] present a fuzzy expert system for diagnosis of Hepatitis B and also they have compared this study with adaptive neural network fuzzy system. They have achieved the 96.4% accuracy for diagnosis of liver diagnosis. **X.Y. Djam et al. [17] designed and developed** a fuzzy expert system for diagnosis of malaria disease. In this paper they have explained from expert system till implementation of fuzzy expert system. They have tested their expert system in 35 Patient with brief explanation of all the input variable and fuzzy rule base. **Tanmay Kasbe and Ravi Singh Pippal** [18] presented a survey paper on dengue fever. They have explained all the symptom with previous research on dengue and also mentioned the first vaccine of dengue fever.

III. MEDICAL DIAGNOSIS SYSTEM METHODS

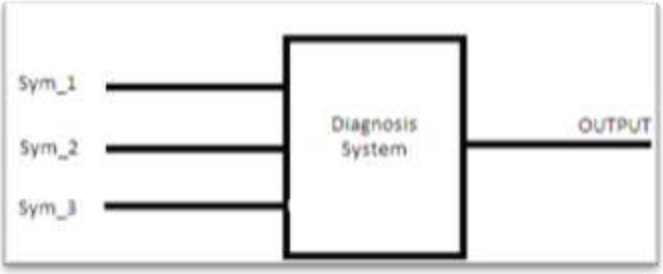

Fig. 2: Diagnosis System

There are numerous approaches and methods used by researcher to deal with medical diagnosis but as we have already discussed, fuzzy expert system are one of the best approaches for implementation. In fuzzy expert system, two parts are very important. First one is Input which is in the form of disease symptoms, after that we have make a rule on the basis of expert suggestion which is in the form of AND/OR with IF notation. Then in the last step, we have insert an input on the base of authenticate dataset and view the disease level as in the form of output.

In below section, we have provided a short view of MATLAB and it is used as a fuzzy interface system or normally we can say that it is a graphical user interface (GUI).

A. Input

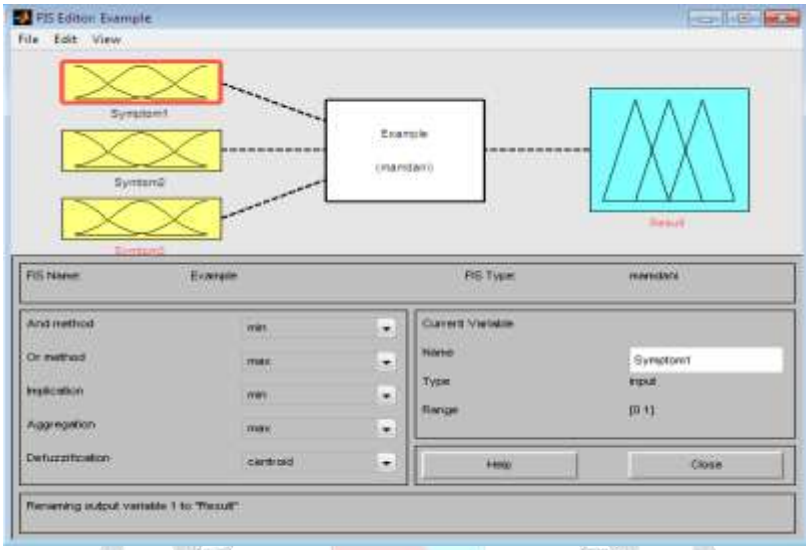

Fig. 3: Input Variable Declaration

In the above diagram, there are three symptom of disease. For example, when we have implemented Dengue Fever then Temperature, WBC, AST/ALT are the three symptoms [18].

If we have more symptoms then we can create more inputs. After that we have to define membership function for each symptom. Basically membership function is used to define a range of value.

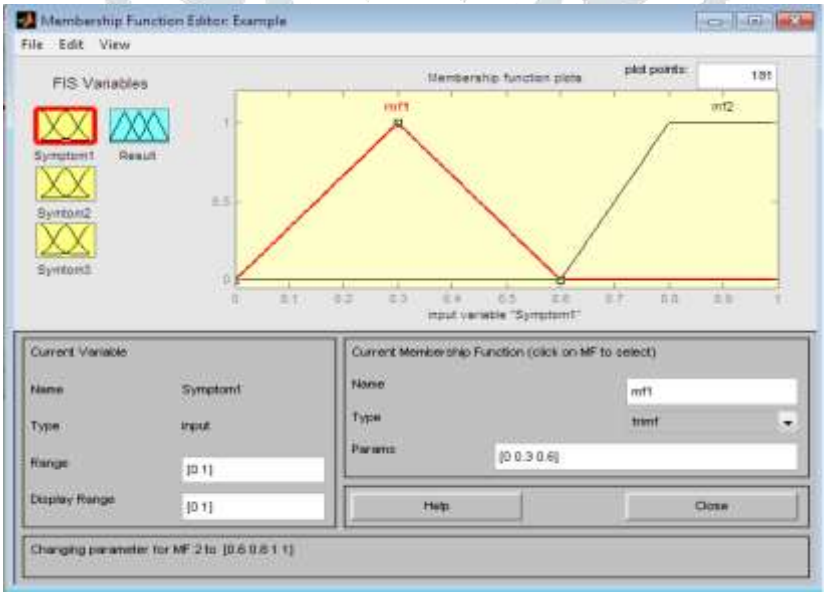

Fig.4: Membership Function Editor

B. Rule Viewer

It is the main part of FIS. Output is completely depend upon the rule and it is belongs to the 'if else' notation. In this we have combine one or more than two input attribute and provide an output. You can create an N number of rules according to expert in the field.

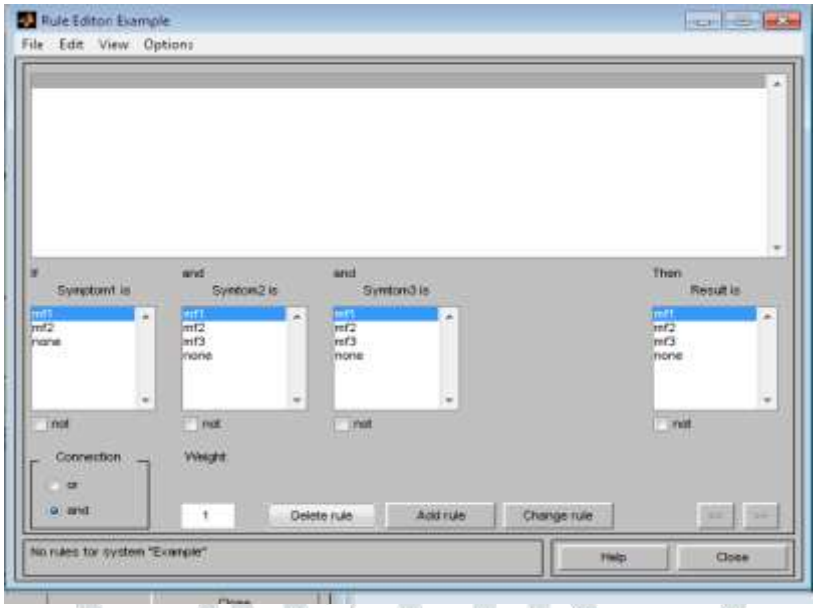

Fig.5: Rule Viewer Editor

C. Output

It is final step of implementation of any disease and in this step we have provide the values of input attribute. On the basis of input values and rules, output is generated.

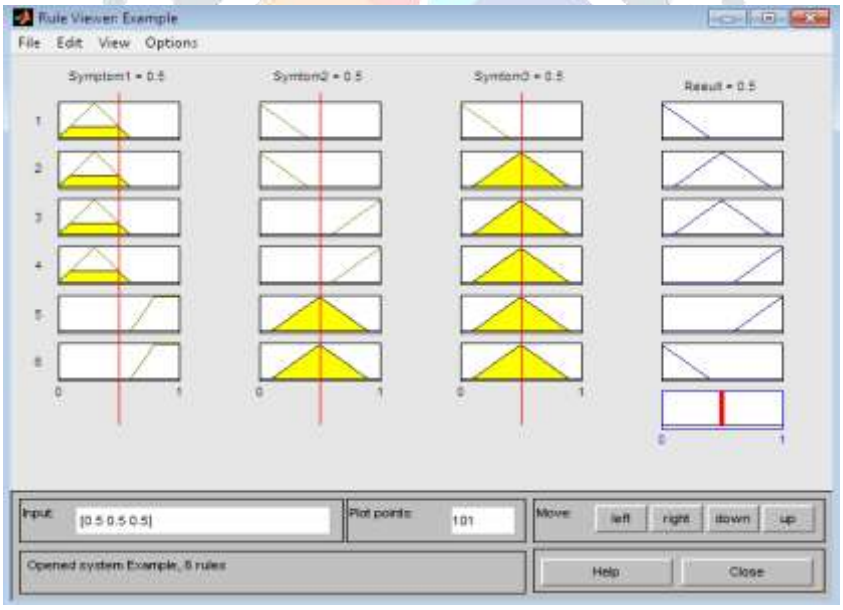

Fig.6: Output Viewer Editor

IV. MEASUREMENT OF ACCURACY

In expert system, accuracy is very important and when it deals with medical diagnosis than it become more important because it is related with real life. Lots of researcher implemented expert system for same diagnosis but higher accuracy achieved by the researcher is the important. In below, we are providing **confusion matrix** for calculating accuracy:

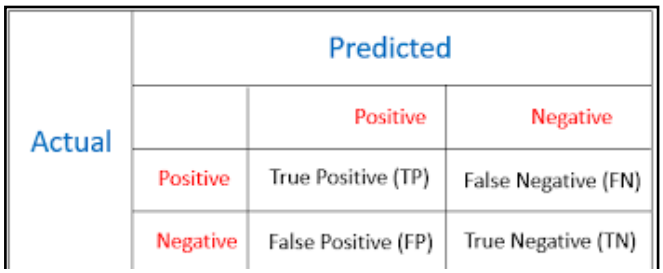

Fig.7: Confusion Matrix

Sensitivity = TP / (TP + FN)

Specificity = TN / (FP + TN)

Accuracy = (TP+TN) / (TP+TN+FP +FN)

- True positive (TP): correct positive prediction
- False positive (FP): incorrect positive prediction
- True negative (TN): correct negative prediction
- False negative (FN): incorrect negative prediction

V. HIGHEST ACCURACY IN DIFFERENT DIAGNOSIS

Table 1: FES FOR DIFFERENCE DISEASE WITH HIGER ACCURACY

Author Name	Disease Diagnosis Name	Accuracy
S. Muthukaruppan & M.J. Er	Coronary Artery Disease(Heart Disease)	**93.27 %**
Varinder Pabbi	Dengue Fever	**95 %**
M. Neshat et al.	Liver Diagnosis	**91%**
Mehdi.Neshat & Mehdi.Yaghobi	Hepatitis B	**96.4%**
I Ketut Gede Darma Putra	Tropical Infection Disease	**93.99%**
M. Zarinbal et al.	Diagnosing Brain Tumors	**91%**
Kunjal Bharatkumar Mankad	Chikungunya	**88%**
M. Kalpana and A. V. Senthil Kumar	Diabetes	**90 %**
S. Amrollahi Biyouki et al.	Thyroid Disease	**89.09%.**
Shakil Ahmed et al.	Kidney Disease	**86.7 %**
Faezeh Roshani et al.	Breast Cancer	**93 %**
Ahmet Yilmaz et al.	Iron deficiency anemia	**90%-95 %**

VI. CONCLUSION

In this paper, we have presented a role of fuzzy expert system in medical disease diagnosis. There are lots of techniques to develop an expert system but here in our paper we have used only one approach which is implementation by MATLAB. For better implementation of diagnosis system, we required input variables which are based on the symptoms of disease. We can collect

database from any hospital or UCI machine repository. As we have seen that in MATLAB rules are the key concept and if we have not make proper rules according to disease then we cannot created an expert system with high accuracy, so rule making is one of the core part.

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